Analysis of Electric Heavy-Duty Driving and Infrastructure Requirements Within A Regional Area

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Overview

Timeline

- Start date: October 2020
- End date: March 2024
- 30% complete

Budget

- Total: $441k
  - DOE share: $396k
  - EPRI share: $45k
- FY 2021: $243k
- FY 2022: $142k

Barriers and Technical Targets Addressed

- Infrastructure costs for heavy-duty vehicles are currently uncertain and likely high
- Increasing adoption will require rapid expansion in distribution capacity, especially since heavy-duty loads are expected to be concentrated
- Exploring baseline costs and mitigation options will increase understanding of the challenges to heavy-duty electrification

Partners

- National Renewable Energy Laboratory (NREL)
- Salt River Project, Xcel Energy, Tri-State Generation and Transmission

Relevance

Objectives

- Model the distribution system upgrade requirements and costs to install chargers for heavy-duty trucks, both for depots and en-route electric “truck stops”
- Estimation will be done using real utility system data
- Once baseline costs are estimated, mitigation options will also be modeled
- Currently costs are poorly understood, so this project will provide an important datapoint for understanding the costs to scale heavy-duty electrification

Status

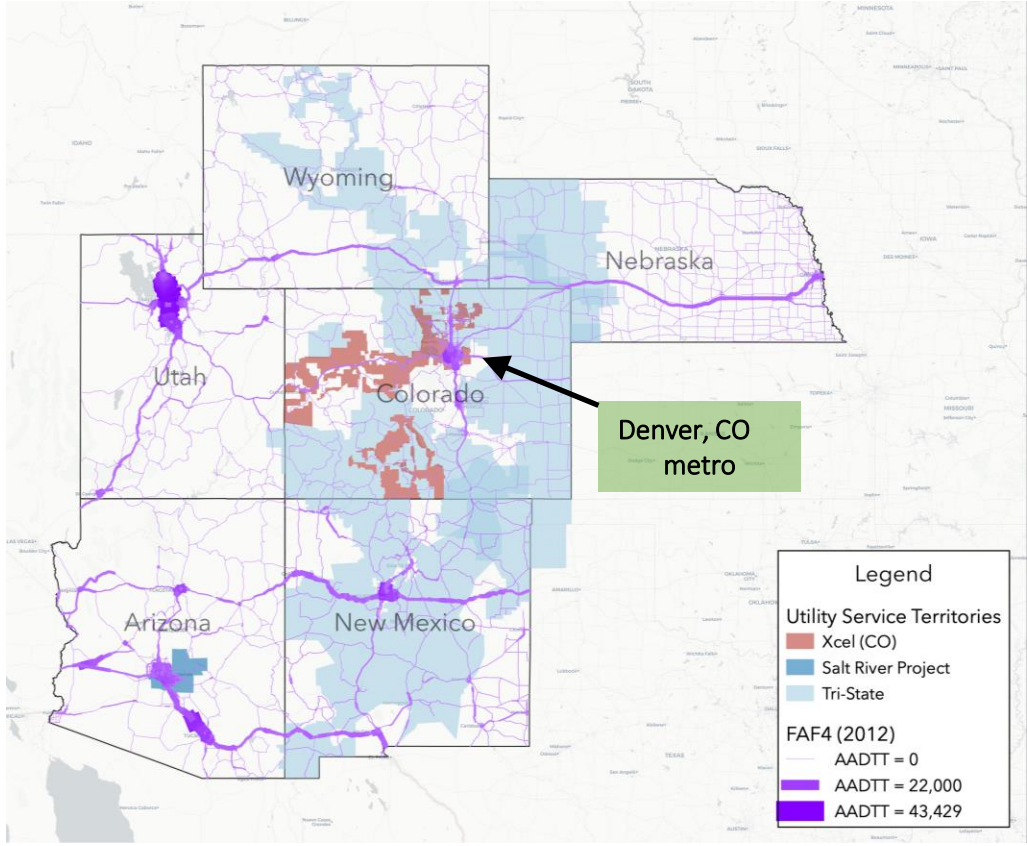
- For depot charging, utility data has been collected, load shapes have been modeled and initial analysis has been performed
- For en-route charging, load shapes have been modeled and cost estimations have been completed

Approach

- NREL is performing freight transportation modeling to estimate the load shape for heavy-duty electric trucks
- EPRI is modeling the upgrades that would be necessary to supply electricity to this load in urban depots, based on data for actual circuits from our utility partners
  - Two depot charging locations will be modeled for a range of adoption levels, along with modeling of cost mitigation options such as on-site energy storage
- Tri-State is modeling the necessary upgrades for rural truck stops for en-route charging
  - Four en-route charging locations will be modeled; due to the more cost-intensive nature of this modeling only the highest load level will be modeled

Technical Accomplishments and Progress

- Our objective for the first year was to perform the freight transportation modeling to generate load shapes, gather necessary data, and perform initial runs to confirm that the model was correctly configured
- All of this was completed:
  - Transportation modeling was performed and load shapes were derived
  - Utility data was gathered and formatted for use
  - Initial modeling for depot charging was performed
  - Final modeling for en-route charging was performed
- This sets us up for full modeling in 2022

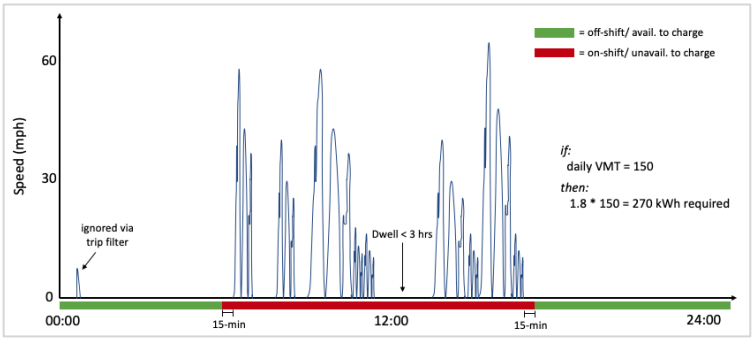


Freight Modeling Process

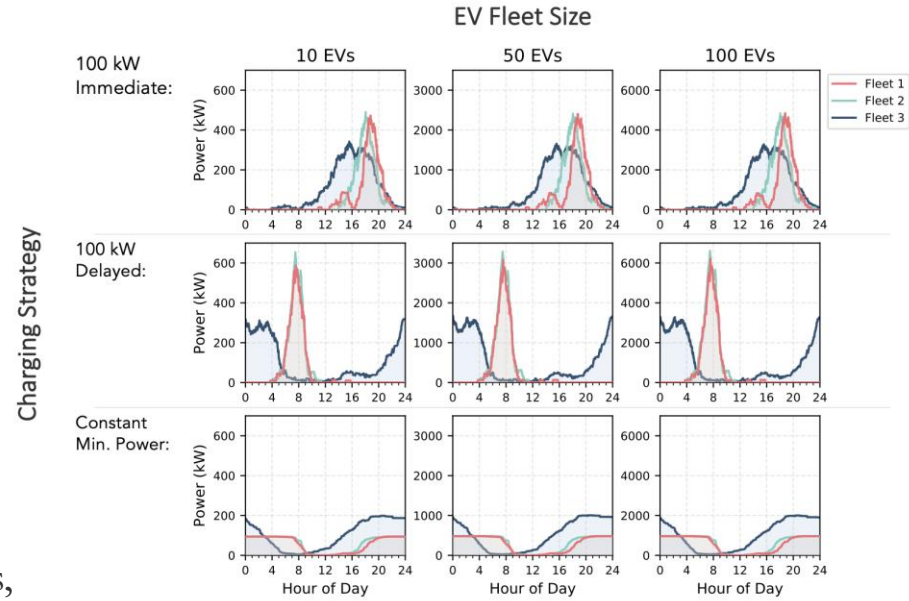
1-Hz Fleet Operating Data

Fleet DNA

Driving day



Bootstrap sampling of operating days, simulate load profiles for various charging strategies, EV fleet sizes



Responses to Previous Year Reviewer’s Comments

- This is the first year that the project has been reviewed

Collaboration and Coordination with Other Institutions

- EPRI is the prime for this project and is performing grid modeling for depot chargers
- NREL is performing freight transportation modeling
- Salt River Project and Xcel Energy are providing data on the connections in the system and the existing load on lines and transformers (on a voluntary basis)
- Tri-State is performing grid modeling for en-route chargers (on a voluntary basis)

- We believe that the combination of NREL's freight transportation modeling, actual grid data, and EPRI and Tri-State's grid modeling will provide best-in-class estimates of the cost for heavy-duty electric vehicle charging

Proposed Future Research

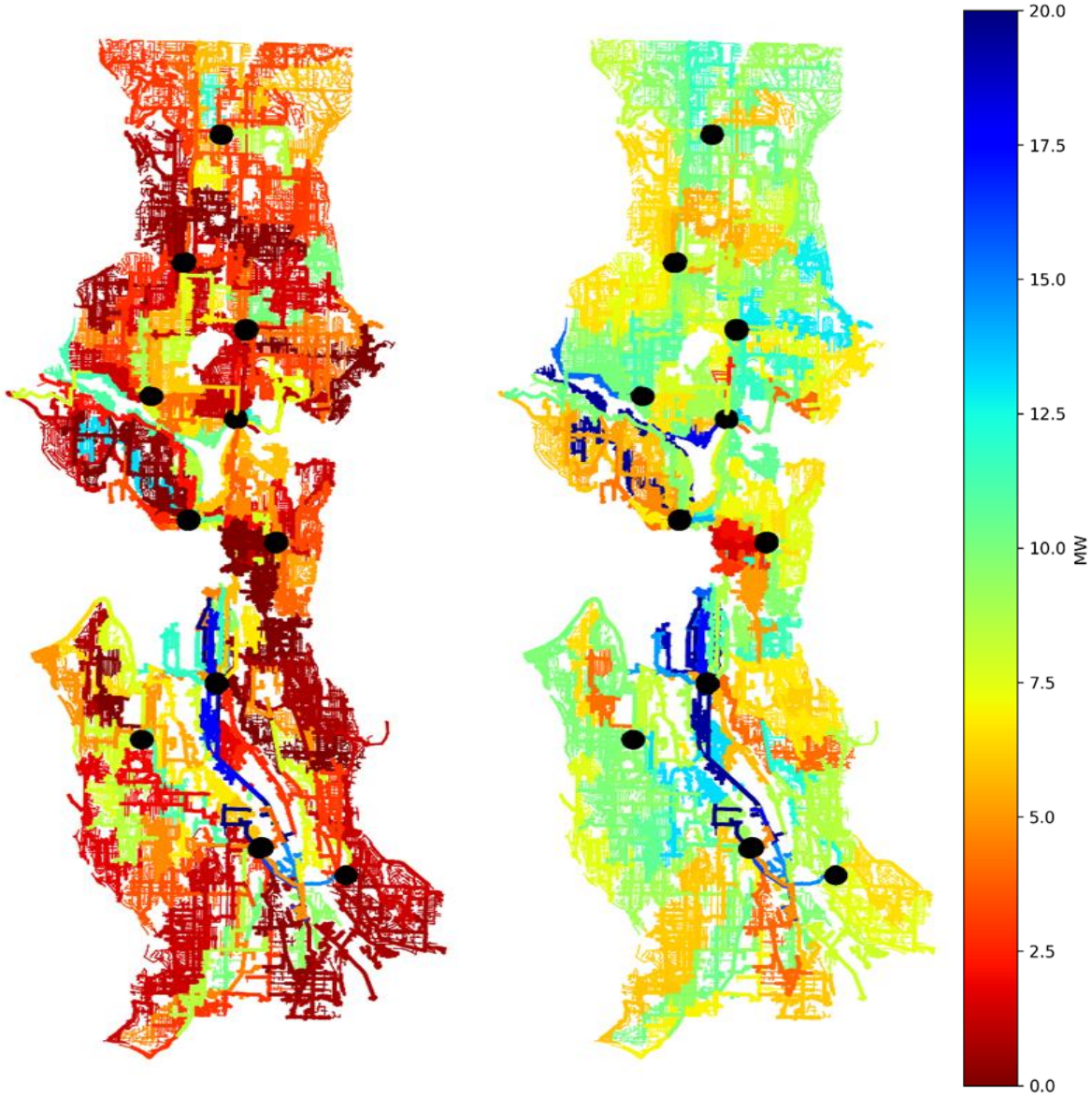
- The next phase will involve execution of modeling; we are confident in being able to do this but there is always some risk of failure
- The other main tasks are designing mitigation options and attempting to make the results as generalizable as possible; these are both open-ended and will require continued work

  - FY2022
    - We plan to perform final modeling of depot charging configurations
    - This will include modeling a variety of adoption levels and potential mitigation options such as on-site energy storage
  - FY2023
    - We will document the results in a final report and hold a workshop to discuss the results

Any proposed future work is subject to change based on funding levels

Summary

- We are modeling the distribution system upgrade requirements and costs to supply charging to heavy-duty trucks, both in depots and in en-route truck stops
- Data gathering and initial modeling has been successful
- Final modeling will be performed this year and the results will be documented next year



Thank you!

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